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ABSTRACT

This monograph, the sixth in a series on the development of the reading process, is concerned with the development of reading comprehension. In the first chapter, "Comprehension in Listening and Reading: Same or Different," Joseph H. Danks analyzes the evidence for the proposition that the comprehension processes for language in print and language in speech are the same and for the contrary proposition that there are significant differences in the understanding of the message in print and speech. In the second chapter, "Arguments for a Constructive Approach to Comprehension and Memory," Kathy Pezdek reviews pertinent research literature on comprehension from the constructive memory approach to the issue. She makes a case for the proposition that the meaning of a sentence is not simply the sum of the separate meanings of the individual words and that sentence comprehension is in a very real sense the determiner of the words of the sentence. She also reviews factors of constructive memory that influence reading comprehension. (MKM)

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IRA series on the development of the reading process

READING AND UNDERSTANDING

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Foreword

It is particularly fitting that the International Reading Association should publish this *Series on the Development of the Reading Process* for the volumes in this series exemplify the value of reading—the value of the printed word. The Series originated in a four-week summer institute at the University of Delaware. Those fortunate people who were able to participate in the institute counted it an enriching experience. How does one share such an experience at a reasonable cost with thousands of others who will wish they might have been present to participate? Through the medium of print. In this IRA series, participation in that unusual institute is available to all interested readers.

The volumes in this series represent more than just a series of papers presented at the institute. They incorporate ideas raised in the discussions at the institute and new developments interpreted through perspectives engendered by the institute.

This *Series on the Development of the Reading Process* deals with important basic issues that are fundamental to understanding the changing nature of the reading process as both the process and the child develop. In the literature on reading, these issues—such as the development of the child's cognitive abilities, the development of the child's semantic system, the child's changing conceptions of language, and the developing relation between listening and reading—are often referred to knowingly as if they are well understood or as if mere reference to them will prove a point. In this series, however, each volume deals with one such basic issue in a comprehensive way and specifically in relation to learning to read.

The person with the vision to develop the institute and with the wisdom and commitment to see that the fruits of the institute were made available to others is Frank B. Murray, editor of this series. The International Reading Association and all who value a deeper understanding of the development of the ability to read are indebted to him for his vision and his labor.

WALTER H. MACGINITIE

Preface

In this sixth monograph in the IRA *Series on the Development of the Reading Process*, we shift the focus somewhat from what it has been in the preceding issues where the focus has been placed upon the factors which influence decoding. Here we take up the larger issue of reading comprehension.

Joseph Danks, in the first chapter, analyzes the evidence for the proposition that the comprehension process for language in print and language in speech are the same and for the contrary proposition that because of significant differences in etiology of speech and reading, in the message structure of each and the processing demands each makes, there are distinct comprehension processes for print and speech. While the obvious experimental test of the two propositions might consist of an analysis of the relative comprehension of the same message in print and speech, Danks exhaustively treats the many methodological issues and factors which prohibit such a simple solution to the problem. As each proposition yields different pedagogical strategies for the reading curriculum a detailed treatment of each merits attention.

An adequate account of language comprehension, whether in print or in speech, cannot be dissociated from the fact that the knowledge the reader or hearer brings to and takes away from the message is stored memory. The measurement of comprehension is inevitably a measurement of memory. Kathy Pezdek critically and comprehensively reviews pertinent research literature on comprehended material from the perspective of a constructivist approach to the issue. This approach emphasizes the reader's active processes which extract, distort, create or construct meaning out of the message stimulus.

Pezdek makes a good case for the proposition that the meaning of a sentence is not simply the sum of the separate meanings of the individual words and that sentence comprehension is in a very real sense the determiner of the words of the sentence. The whole is greater than the sum of the parts

throughout this approach. What is comprehended in reading is dependent upon the factors of constructive memory Pezdek reviews. Reading comprehension is a construction. Some clues to the form of the construction are outlined.

The series is organized around the notion that the child's reading behavior, among other things, is a developmental phenomenon. This means that, like other developmental phenomena, there are certain necessary and sufficient conditions for it and that it changes both quantitatively (it becomes faster and more efficient) and qualitatively (different and more complex models are needed to explain it) as the child ages. The series will examine the development of reading from the perspective of the perceptual, cognitive, neurological, and linguistic prerequisites for it; specific factors in its acquisition; and factors which lead to the enhancement of the reading skill once it has been acquired.

During the summer of 1974, the Society for Research in Child Development, with the support of the Grant Foundation of New York, sponsored a four week interdisciplinary institute at the University of Delaware on Reading and Child Development. The thirty-three institute faculty were researchers in the disciplines of psychology, psychiatry, education, linguistics, neurology, sociology, and the law. Each spent from three to five days at the institute, both formally and informally presenting the applications of their research to the field of reading.

The institute participants were advanced doctoral students and postdoctoral faculty from various disciplines who had an interest and commitment to research in reading. They were present for the full four weeks, and some of them are contributing authors to this IRA *Series on the Development of the Reading Process.*

The success of the institute, upon which this series is based, was due to the energies and talents of many people. In addition to the dedication of the participants, faculty, and administrative staff (whose names appear elsewhere in this issue), the staff of Clayton Hall and the Department of Educational Studies of the University of Delaware, and the members of the Long Range Planning Committee of the Society for Research in Child Development contributed

substantially to the planning and execution of the institute. Finally, the series itself was greatly improved by the editorial assistance of Lloyd Kline and Faye Branca of the International Reading Association.

Frank B. Murray

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The International Reading Association attempts, through its publications, to provide a forum for a wide spectrum of opinion on reading. This policy permits divergent viewpoints without assuming the endorsement of the Association.

Comprehension in Listening and Reading: Same or Different?

JOSEPH H. DANKS
Kent State University

"In order to read with comprehension, all the beginning reader has to do is pronounce the words correctly at a reasonable rate. His oral language comprehension processes will then suffice." Many researchers have tacitly assumed this proposition in their interpretation of research results and in their proposals for reading programs. Others have assumed the opposite, namely, that reading comprehension requires cognitive processes that are different in some major respects from those of listening. The fact that these assumptions are rarely made explicit should not lull us into overlooking them. Researchers have presented few data to support either assumption. Indeed, a cursory review of the literature reveals that data sufficient to resolve the issue are not available, primarily because of flaws in the rationales, designs, and procedures of the studies.

This chapter is divided into three sections. First, the two extreme positions are identified and elaborated, drawing from published writings of several well-known reading professionals. The implications for educational programs that follow from assuming each stance are identified. In particular, how one teaches reading and/or English and/or language arts in the later elementary school years is determined in large measure by the assumed relation between oral and printed communication systems. In the second section, methodological problems with empirical studies that bear on the issue are reviewed and illustrated. Finally, a task analysis is proposed that would direct research toward a valid comparison of listening and reading comprehension.

The discussion here is limited to what has been commonly called the comprehension aspect of reading in contrast to decoding. Word identification, which completes the

decoding phase, provides the grist for comprehension. However, when the dichotomy is pressed, it is difficult to maintain, for example, Ryan and Semmel (1969) describe the "downstream" influence that comprehension has on decoding. The decoding phases of listening and reading are necessarily different by virture of the different modalities of input and the amount of control the recipient has over the input flow. A listener has minimal control over the auditory signal which rapidly fades. A reader, on the other hand, has reasonably complete control over the amount and rate of visual input which is continuously available for reprocessing. If there is not a sharp break between decoding and comprehension, as there well may not be, then the different processing mechanisms at the decoding end may have a marked influence on the later comprehension stages. In general, this chapter focuses on comprehension and not decoding although this separation may be a fiction that ultimately cannot be maintained.

The Two Extremes

A Unitary Comprehension Process

There has been considerable discussion about the relation between a reader's processing of speech and print. Two conferences, reported in Kavanagh (1968) and Kavanagh and Mattingly (1972), were devoted to exploring this relationship. In the first conference, Alvin Liberman discussed several differences between listening and reading. However, all of his points focused on decoding speech and print into language, all of which presumably occurs prior to processing for meaning. As conveyed by the title of the report of the second conference, *Language by Ear and by Eye*, the emphasis there was also on the more peripheral aspects of the relationship, that is speech perception and reading implicitly defined as decoding. Few of the papers in that volume even hinted at the problem of comprehension and the similarities or differences as a function of mode of linguistic input. For the most part, the participants did not question, at least in the printed record of the conference, the assumption that once past word identification, the processes of comprehending speech and print do not differ.

The position that a unitary comprehension process is activated regardless of mode of input has been attributed in recent years to the proclamation of linguists that speech is primary and that print is a poor second cousin in the language family. The position was stated most decisively by Fries (1963. xv).

> Learning to read... is *not* a process of learning new or other language signals than those the child has already learned. The language signals are all the same. The difference lies in the medium through which the physical stimuli make contact with his nervous system. In 'talk,' the physical stimuli of the language signals make their contact by means of sound waves received by the ear. In reading, the physical stimuli of the same language signals consist of graphic shapes that make their contact with his nervous system through light waves received by the eye. The process of learning to read is the process of transfer from the auditory signs for language signals which the child has already learned, to the new visual signs for the same signals.

Psychologists interested in reading have frequently maintained a similar posture. For example, the research group at Cornell University who have been actively studying the reading process under the leadership of E. Gibson and H. Levin, have accepted a unitary comprehension process.

> Publications of the Gibson group suggest the model of the reader as "speaker, then hearer." The task of the reader is to translate graphemes into phonemes. This is the task particular to reading. After decoding to speech has been accomplished, comprehension processes associated with speech comprehension are brought into play [Wanat, 1971: 8-155].

In fairness it should be noted that Gibson (1972) in her keynote address to the conference reported in Kavanagh and Mattingly hinted that this position may be wrong. She commented that researchers have assumed that a reader's knowledge of grammar for oral language is transferred automatically and directly to the reading process but that this assumption may not be justified.

The assumption of a single comprehension process following initial decoding of either sound or print also has been

readily accepted by educators and educational psychologists. In many cases the assumption is not even made explicit and, when it is, it is noted in passing with the implication that a point so obvious scarcely bears mentioning. Note these examples from two prominent educational psychologists who spoke at the institute.

> The process of reading comprehension differs from the process of language comprehension only in the form of perceptual input. The latter works from oral input; the former from visual input [Goodman, 1966: 168].
>
> Performance in reading, at least after the basic decoding skills are mastered, is primarily an indicator of the general level of the individual's thinking and reasoning processes rather than a set of distinct and specialized skills [Thorndike, 1973-74: 135].

In sum, a frequently held position is that once the reader or listener has translated the particular form of input into an abstract coding, language is language. The language code is either an abstract code that is independent of the modality of input or a speech code to which print is decoded.

What effect does holding a unitary process view have on educational practice? Many school systems have accepted this position, albeit implicitly. Witness the fact that in many elementary schools, "reading" as a separate subject is taught only in the first two or three grades. At that point the teacher stops teaching reading and teaches language arts or English. The implicit assumption is that once the child has acquired decoding skills, training and practice with one form of language will transfer to other forms. This educational practice is not based on some amorphous notion of generalized transfer. Listening skills place an absolute ceiling on the level of reading skill a child may attain. As Bormuth (1972) has noted, "in the tradition and folklore of reading instruction, a student's ability to comprehend spoken language is regarded as an estimate of the upper limit of his capacity to learn reading comprehension skills" (p. 1134). Such an assumption demands that if education is to increase reading skills, oral language skills must first be increased beyond the desired level of reading. This strategy has been most evident in proposals

for the remediation of supposed language deficits in speakers of dialects other than the dialect found in primers. Therefore, instead of teaching reading of prose, one should attempt to increase general verbal fluency, vocabulary, and even general knowledge. The only special training necessary with regard to print would be to emphasize reading speed and to introduce a variety of literature and other reading materials.

The assumption of a single comprehension process has also led to the language experience approach of teaching decoding. In the now popular technique, the teacher writes out a story told orally by a child so that he can read it later. The implicit reasoning behind the value of this exercise is that the child will learn to read easier and faster if he discovers the similarity between processing speech and print. Since the material is already meaningful to him, the comprehension process used for oral language can be more efficiently and smoothly activated while reading. In addition, the material is more relevant to the child's here-and-now, which also may facilitate comprehension. One cannot help but note from the vantage of a dual comprehensive process view, however, that when the teacher writes down what the child says, he or she implicitly admits that the language found in the child's primers is not the same as what the child himself speaks, and further that the language the child speaks is better for him to practice reading. If so, then the comprehension processes might not be the same for both speech and print. Let us now consider the dual process view.

Dual Comprehension Processes

As one might surmise from the previous section, few researchers in reading have claimed that the comprehension of speech and the comprehension of print involve totally different processes. However, some have questioned the assumption of a unitary process. Referring to "a student's ability to comprehend spoken language," Bormuth (1972: 1135) claimed that "although reading and listening abilities share some elements in common, they exhibit substantial differences, and ... we can no longer use listening abilities to estimate reading aptitude in the simple fashion we heretofore thought possible."

Weaver and Kingston (1971b) discussed the difference between listening and reading from the child's perspective of learning to do each. They mentioned several differences between learning oral language and learning to read print. One point in particular is germane to the present discussion. "The transfer of 'meaning' from spoken to graphic representation may not be the direct, simple operation commonly assumed" (1971b: 8-185). "Meaning" includes more than definitions of isolated words, but also the meanings of sentences integrated with the meanings of other sentences, context, and the reader's prior experience. Thus, in a word, "transfer of 'meaning'" is comprehension. Good oral language skills are clearly necessary for learning to read. However, the issue is whether oral comprehension skills are sufficient for becoming a skilled reader when combined with well-practiced decoding skills.

In his "Reflections on the Conference" reported in *Language by Ear and by Eye*, Miller (1972) noted a historical development that tangentially bears on the point that comprehension is not unitary. Writing did not originate as a more permanent form of speech. Rather writing, as pictographs, evolved independently of speech as an alternate form of communication. This development of writing was considerably later in man's evolution than speech. Only recently in mankind's history, say 3000 years ago, was writing associated more directly with speech when an alphabet was invented. It is invalid to rely wholely on diachronic arguments to explain ontogenetic and sychronic processes, but the historical development of writing vis-à-vis speech is suggestive that the two language processes may not be identical.

A final argument that there may be at least two comprehension processes—one for listening and one for reading—comes from the notion that speech and print are sufficiently different so as to demand different processing strategies. It is often assumed that the way we talk is considerably different from the language of what is read. What would be a "sufficient" difference to necessitate different comprehension processes? In what respects is print different from speech? Aristotle claimed that "the style of written prose is not that of spoken oratory" (1928, p. 1413b). Has knowledge

on this point advanced in the intervening 2300 years? Many would claim that there are large differences in grammar, vocabulary, and style in what we write and in what we say. To the extent that differences are present, there well may be concomitant differences in the cognitive processes required for efficient extraction of meaning. Material produced for one channel is comprehensible when received in the opposite one, but processing may be more strained than when compatibility of production and reception modality is maintained.

Now consider what one would do in the classroom if the dual process view of comprehension were correct. Most importantly, once the child is able to decode one would not stop teaching reading. The teacher would teach reading specific skills that would lead to more efficient and faster reading. Among these skills would be previewing, outlining, maximizing the amount of material per fixation, and minimizing regressions. The teacher could also teach those comprehension skills that are peculiar to print. For example, how to analyze the structural properties of prose sentences and paragraphs, or how to follow the styles of thesis development and argumentation would be appropriate. Knowing specifically how speech and print differ would be important in designing these curricula. Clearly, teachers must not ignore speech and oral language skills: they are much too critical to relegate to haphazard development. Based on any real differences uncovered between speech and print, appropriate instructional programs could be developed.

A Compromise

The positions drawn here are extreme ones. Those who claim dual comprehension processes certainly would not be so extreme as to say that the two processes are totally unrelated systems triggered by different modes of input. Likewise, it is unlikely that those who hold a single process view would say that there are no differences whatsoever. Some intermediate position is more probable.

The processing that the listener-reader must perform on the input may be heavily influenced by the purpose for which he/she is attending to the material. Typical listening situations are conversing over coffee or cocktails, and listening to

the news on TV. Common reading contexts are reading the newspaper for information and a novel for entertainment. To what extent theoretical and experimental considerations apply to these typical situations must be carefully evaluated. The issue is more than the usual plaint about the generalizability of laboratory findings to the "real world," however, because there are so many real world contexts to be accounted for. Is it reasonable to assume that a single comprehension process can be defined for the multifarious real world contexts? Is listening comprehension in a conversation the same process as listening comprehension of a lecture? Or does the latter process have more in common with reading a text on the same topic? What about reading a play? Don't we hear the players speaking to us from the stage? There well may be commonalities in listening and reading comprehension, as well as some differences, but comparison of the wide variety of tasks that are included under the labels "listening" and "reading" will eventually be necessary. In the long run, an absolute answer to the question of whether listening and reading comprehension are unitary or not may not be possible because there is as much or more variability within each skill than between them. Before evaluating this possibility, let us review the studies that bear on listening and reading. Is the evidence adequate to identify in sufficient detail points of similarity and difference in listening and reading comprehension so that one can specify the underlying processes?

The Evidence

Superficially, the experimental design for resolving the question of whether listening and reading comprehension are the same or different is simple. Present "identical" material aurally (as speech) to one group of subjects and visually (as print) to another, then test their comprehension. If equal amounts and types of material are comprehended, then listening and reading comprehension processes are likely to be the same (unitary), but if different amounts are comprehended then the processes must be different (dual). However, there are numerous logical and methodological pitfalls in such an

experiment. These problems can be categorized as relating to presentation conditions, subject characteristics, language materials, and comprehension measures. As the research relevant to each of these four major classes of variables is reviewed, pitfalls are identified and designs that might be used to circumvent those particular problems are suggested.

Presentation Conditions

The primary manipulation for the comparison of listening and reading comprehension, is, of course, whether the material is presented as speech or in print. Yet there are certain physical properties of the presentation media as well as gross differences in listening and reading decoding that must be considered to insure comparability of the two conditions. The presence of suprasegmentals in speech undoubtably facilitates the listener's veridical understanding of the message. Although punctuation marks may provide some of the same type of information to a reader, it is doubtful that they can code anywhere near as much information as suprasegmentals can. The set of punctuation marks is far smaller than the range of stress, intonation, pitch, and speed possible in speech.

Under typical reading conditions a large segment of the material is before the reader at any point in time, while during listening the listener has access only to a relatively short segment amounting to no more than a few words or phrases. Since it is difficult, if not impossible, to provide a listener access to a larger segment of material, an investigator must focus on restricting the amount of material available to a reader. This restriction should be effected without causing the reader to alter substantially the processes he normally uses in reading. A limited amount of material, say a line or two of text, could be presented for a relatively brief period (Young, 1973), either at a fixed rate or subject paced. Too fast or too slow a presentation rate would reduce comprehension because too much or too little information would be available to process. The size of the segment presented and how it is segmented would also be likely to influence the fluidity of reading. Since subjects integrate at the end of clausal boundaries (Bever,

Garrett, and Hurtig, 1973; Jarvella, 1971), maintaining clausal units would facilitate comprehension.

A second difference between listening and reading presentation modes is the amount of time that the functional stimulus is available to the subject. Because of differences in typical listening and reading rates, time is likely to differ markedly unless specifically controlled. Typical silent reading rates are two to three times faster than normal speaking rates (100 to 150 words per minute for speaking versus 300 to 400 words per minute for reading). Thus, readers given the same length of time to read a passage that listeners require to hear that same passage may have time to rehearse or reread the material. Though many studies have equalized listening and reading times (Corey, 1934; Durrell, 1969; Horowitz, 1968; Horowitz and Berkowitz, 1967; Sticht, 1968), they failed to equalize functional listening and reading times. Since comprehension was tested with immediate recall, they compared memory in conditions with functionally different study times.

One solution to this problem has been the use of compressed speech. The most common technique to compress speech without increasing the pitch is to excise very short segments (shorter than a single phoneme) on a random basis. Numerous studies have shown that speech compressed to 275 to 300 words per minute, close to typical reading rates, can be understood with minimal or no loss of comprehension (Foulke, 1968; Rossiter, 1971). Compression to higher rates results in a sharp drop in comprehension although comprehension can be maintained at rates over 400 words per minute with training (Orr, Friedman, and Williams, 1965). Even elementary school children are able to comprehend compressed speech at rates of 225 words per minute (Woodcock and Clark, 1968). Jester and Travers (1966) tested college students for comprehension at listening and reading rates of 150 to 350 words per minute with a multiple-choice test. At the lower speeds (about 200 words per minute) listening was generally superior to reading, but at the higher speeds (about 300 words per minute) reading was superior. Not only does compressed speech permit the equalization of study times for reading and listening, but also the fact that the maximally efficient input rate is the same for

listening and reading suggests that there may be some commonality in processing.

As a practical matter, educators have frequently considered whether there is transfer of listening comprehension training to reading, particularly in elementary school children. If listening and reading comprehension are handled by a single process, then training in one should produce equivalent improvement in the other. But if there are two distinct processes, or processes that overlap only marginally, then the transfer should likewise be marginal. The frequently obtained moderate correlation between scores on standardized listening and reading tests (cf. Duker, 1965; Kennedy, 1971) does suggest the possibility that improvements in listening skills may facilitate reading acquisition.

Reviewing five reviews of the literature on whether there is transfer from listening training to reading, Kennedy (1971) found three early reviews that concluded there was positive transfer. However two later ones, as well as her own review, concluded that there were only inconsistent or no effects of listening training on coding skills. Most of the studies reviewed took a rather limited view of potential transfer variables. Many of the studies (e.g., Lewis, 1952) trained general listening skills such as determining the main idea, noting details, and drawing conclusions and inferences. They then tested for general transfer to reading achievement. Not surprisingly, the results did not show clear transfer effects.

On a specific level, positive transfer does occur. Both Orr (1966) and Thomas and Rossiter (1972) found that reading practice paced by listening to compressed speech increased normal reading rates up to 350 words per minute. Further, the increase in reading rates was not accompanied by any loss in comprehension and the effects on reading were still present nine months after the conclusion of only ten days of training (Thomas and Rossiter, 1972).

Kennedy (1971; Kennedy and Weener, 1973) tested whether training on listening or reading comprehension would improve comprehension in the other mode. Third graders who were below grade level readers were trained for five 20-minute sessions on either a written (reading) or oral (listening) cloze

procedure. They were then tested on the Durrell Listening-Reading Series and on new cloze comprehension tests in both written and oral forms. Training on either the written or oral cloze produced equivalent positive transfer on both the written and oral cloze comprehension tests. The effects on the Durrell test were more complicated, however. Relative to an oral reading control group that received individualized attention, training on the written cloze improved reading comprehension but not listening comprehension, and practice on the oral cloze procedure had no effect on either.

While the equivalent cross- and within-mode transfer from cloze training to cloze test was consistent with a single comprehension process, the pattern of transfer to the Durrell tests was not consistent with that conclusion. The prediction training implicit in a cloze procedure may be a relatively restricted language skill that depends as much on nonlinguistic knowledge as it does linguistic rules. Thus, there was specific transfer of the skill regardless of modality. Further, if reading but not listening comprehension involves the prediction skill trained by the cloze procedure, as does not seem unreasonable, then the transfer pattern to the more general Durrell test is expected. Whatever the explanation, these transfer results complicate any conclusion of a unitary comprehension process.

Subject Characteristics

The most obvious variation in subjects relevant to listening and reading is age. Chronological age is not itself the critical variable, but variation in age is concomitant with several acquisition variables that interact with listening and reading. Children usually begin to speak (and to listen) and to read (and to write) at quite different ages and the rates of acquisition of oral language and reading also may be different. In addition, the typical context in which acquisition occurs is the home for speaking and listening and the school for reading and writing. Because of these age-related differences in the temporal and social context of acquisition, comparison of listening and reading at a single chronological age may not be a fair comparison. The linguistic and conceptual complexity of

the material that can be processed easily may differ between listening and reading when tested at a single age. The selection of a subject at a particular age or a decision to systematically vary age must be carefully evaluated.

Although subjects from age six (first graders) to early twenties (college students and military personnel) have been tested in one experiment or another, most studies comparing listening and reading comprehension have concentrated on a single age or at best a limited age range. Considering only a sample of studies, elementary school children were tested by Kennedy and Weener (1973), Swalm (1971), Oakan, Wiener, and Cromer (1971); high school students by Thomas and Rossiter (1972); college students by Singer (1970), Abrams (1966), Corey (1934), Horowitze (1968), and Horowitz and Berkowitz (1967); and U.S. Army recruits by Sticht (1968). Because of the multitude of different materials and procedures used in testing subjects among these studies, no developmental conclusions can be drawn from what is basically a collection of unrelated cross-sectional studies.

One study (Durrell, 1969; Durrell, Hayes, and Brassard, 1969) attempted to compare listening and reading comprehension across a relatively wide age range, albeit for the purpose of validating a test instrument. Tests of listening and reading abilities were constructed in three levels covering grades one through eight and were designed to test both vocabulary and either sentence or paragraph comprehension. Since at each level the same language comprehension tests were used on carefully equated forms, the raw scores were purported to be comparable. In a large scale administration of the test to three to four thousand children at each grade, listening vocabulary was much superior to reading vocabulary at grade one (by a factor of two), but these vocabulary scores were comparable by grade eight. Sentence-paragraph comprehension also started out with listening comprehension better than reading comprehension by a factor of two, but comparable scores were achieved by grade six, and at grade eight reading comprehension was 12 percent superior to listening comprehension.

Durrell's rationale for constructing the listening-reading test was that, assuming a unitary comprehension process,

listening abilities set an upper limit on a child's potential to read. Thus, listening comprehension should always be superior, or at least equal, to reading comprehension. The vocabulary results were consistent with this rationale although at grades higher than those tested reading vocabulary might even be superior to listening vocabulary. However, the sentence-paragraph comprehension results were clearly inconsistent with the rationale. Durrell retreated from his original position to claim that "when comparing reading and listening, the higher score of either indicates a potential for the other" (1969: 456).

Although these results appear to support dual comprehension processes, the Durrell test is too fraught with practical problems to draw any firm conclusions. For one example, although the total time was constant for both listening and reading, this procedure can result in marked differences in actual time available for processing. For another, the items for the comprehension test were selected for their psychometric properties rather than for their ability to tap the underlying processing. In addition, some reading was required as part of the listening comprehension test, resulting in a possible confounding of listening and reading skills. Thus, although the test scores may have statistical comparability, they are probably based on very different scales and should not be directly compared.

No one has attempted to separate general developmental effects from those associated with specific training in reading, except in terms of cognitive readiness to begin reading (Elkind, 1969, 1974). Does the difference in absolute level of reading achievement of, say first and third graders, reflect only schooling, or might not some of the difference be attributable to general maturation or cognitive development? To separate completely these variables would require carefully matched samples of literate and illiterate subjects at all ages, a practical impossibility and perhaps a theoretical impossibility as well. A less extreme strategy to separate these age-correlated changes is to compare good and poor readers. The procedure for obtaining a proper match between good and poor readers is not simple. Further, one should test not only good and poor readers of the same chronological age, but also good readers of a

younger chronological age with the same "reading age" as the older poor readers. Unfortunately, investigators do not always take pains to form their groups such that a difference in reading performance is the only distinguishing characteristic. For example, Swalm (1971) tested children in grades 2, 3, and 4 for listening and reading comprehension by a cloze procedure. Reading comprehension was better than listening for above-average readers, but the reverse was true for below-average readers; listening and reading comprehension scores were equivalent for average readers. However, the classifications probably reflected more general cognitive differences as well as differences in reading performance.

In contrast to Swalm, Oakan et al. (1971) matched good and poor readers on both age and IQ. They found that good fifth-grade readers comprehended standard text equally well when they listened to tape recordings of either another good reader or a poor reader. But, when they read it themselves, the good readers comprehended the standard text better than when they read a transcript of the poor reader reading aloud. Thus, for good readers, degradation of the input effected by filtering it through a poor reader was more disruptive of reading than of listening. In contrast, poor readers' listening comprehension was disrupted by the poorly organized input from another poor reader, but the already poor reading comprehension was not improved by supplementary training on word identification. Perhaps, in accordance with a unitary view of comprehension, one of the reasons that poor readers do not read well is that their listening comprehension skills, which may be necessary for good reading comprehension, are not well established as evidenced by the ease with which they were disrupted.

Another approach to the involvement of listening processes in reading comprehension comes from a study of deaf readers. Conrad (1971) compared reading comprehension of deaf and hearing children following both silent reading and reading aloud. The deaf children were divided into those who used articulatory coding on a short-term memory pretest and those who did not use articulatory coding. While the hearing children and the deaf articulators comprehended equally well in both reading conditions, the deaf nonarticulators were

disrupted by being required to read aloud. Although all of the deaf children could speak, none of their reading could have been mediated by acoustic coding since all were profoundly deaf from an early age. While some of the deaf children (the articulators) used their speech mechanisms to mediate reading, others evidently did not because they were disrupted when required to read aloud. Thus, speech skills may be functional for normal readers, but are not necessary. The results of the normal hearing children, plus other data presented by Conrad (1972), suggest that the favored mode of coding for normal subjects is phonological even when penalized for such coding.

Language Materials

How are speech and print alike? How are they different? If listening and reading comprehension involve the same processes, then written language and speech ought not to be too different in vocabulary, grammar, and style; otherwise, a unitary processing strategy might not be able to handle the differences. On the other hand, to the extent that speech and print are linguistically different, then one might expect to find differences in the processing of each. Differences in speech and print may result from speaker-writer differences because speech is usually feedback sensitive, while print is not. Evidence one way or the other cannot be considered conclusive. However, differences may be suggestive inasmuch as the materials set the task for the listener-reader.

From the widely scattered studies that have compared oral and written productions, the results, for the most part, have not been surprising. Oral productions, compared to written ones on the same topic, contain more words, phrases, and sentences; longer and more difficult words; more verbs; more ideas; more elaboration; and more repetition (DeVito, 1965, 1966; Driemann, 1962a; Horowitz and Newman, 1964; Portnoy, 1973). Most studies have also found a greater diversity of vocabulary in written than in oral production, usually as measured by a larger type-token ratio. This finding may be artifactual, however, resulting from a curvilinear relation between number of types and number of tokens, since more words (tokens) are usually produced in speech. Direct

comparisons of type-token ratios from different sized samples would be appropriate only with a linear relation between the number of types and the number of tokens (Driemann, 1962a).

Introspective reports have indicated that the purpose of a communication, the subject matter, and the characteristics of the recipient affected the composition of written productions more than they affected oral ones (Driemann, 1962b). Written productions are more precisely composed. As a consequence, when production time was limited, written messages were more efficient as measured in ideas per words per unit time (Horowitz and Newman, 1964). But given unlimited time, the faster production rate of speech yielded relatively greater efficiency than handwriting (Horowitz and Berkowitz, 1964). Skilled typing and stenotyping increased the similarity of manual productions to oral productions, but there still were large differences (Horowitz and Berkowitz, 1964).

One surprising result was uncovered by DeVito (1965) when he compared the oral and written productions of ten highly skilled speaker-writers, speech professors at a major university. He found that their oral description of topics from their published papers did *not* differ from the printed version in sentence length defined either in terms of letters, syllables, or words. Further, the written passages contained a significantly *higher* proportion of simple sentences (one subject-verb clause) than did oral productions. Whether this finding is generalizable to other classes of speakers and writers, or is peculiar to these highly skilled writers, needs to be explored further.

Do these differences in production mode make a difference to listeners and readers? DeVito (1965) presented the oral and written productions described above to college students in written form as a cloze test. The cloze scores were nearly identical: both types of passages were equally comprehensible to undergraduates. Portnoy (1973) also used a written cloze procedure to assess comprehensibility of oral and written productions. College students both spoke and wrote paragraphs on "interesting experiences." Confirming DeVito, Portnoy found no overall difference in comprehensibility between production modes. However, there were individual differences among the producers. She identified about half as

"speakers" and the other half as "writers." The speakers' oral productions were significantly more comprehensible than were their written productions, and the writers' written paragraphs were more comprehensible than their oral ones, both as measured by the cloze procedure. There were no overall differences between speakers and writers, however. Speakers' and writers' productions differed on only one linguistic measure—writers used more long words.

A complete design would involve testing comprehension of both production types in both reception modes as well as using additional measures of comprehension. To the extent that listening and reading comprehension processes are different and that speakers and writers are sensitive to such differences, oral productions should be easier for listening and written productions easier for reading. None of the studies that have compared listening and reading comprehension attempted to control or manipulate the origin of the stimulus materials in terms of mode of production. Investigators have completely ignored this issue and most have used written materials produced for reading. These materials are read aloud, invariably by a skilled reader, for aural presentation.

A few studies have used orally produced materials. Based on normative frequencies of occurrence in children's oral language (Strickland, 1962), Ruddell (1965) constructed prose passages using either high or low frequency syntactic patterns. Fourth graders from the same school district from which Strickland drew her sample were tested for reading comprehension with a written cloze procedure. Those paragraphs composed of high frequency syntactic patterns yielded more accurate comprehension than did paragraphs with low frequency patterns. These results support a notion that reading comprehension is related to the syntactic patterns used in speech. This conclusion was verified in a modified replication of Ruddell by Tatham (1970) that used more carefully controlled item selection and a different measure of comprehension.

These two studies can be considered as no more than suggestive, however, because only a few selected syntactic patterns from the multitude of possible linguistic variables were manipulated. In fact, Ackerman (1974) found that

syntactic complexity of written productions correlated significantly with progress in learning to read for first through third graders, but that syntactic complexity in oral productions correlated with learning to read only for third graders. The ideal study would compare both listening and reading comprehension of two types of material. One type would contain structures that have a high frequency in speech but a low frequency in writing. The other type would use those structures having a low frequency in speech but a high frequency in writing. Ruddell and Tatham tested only reading comprehension and only for materials that occurred with a high frequency in speech (frequency in writing was undetermined). This design is a minimal one for sorting out production mode effects from reception mode effects.

Comprehension Measures

That the measurement of comprehension is no simple matter is suggested by the considerable discussion by educators and by experimental psychologists (Carroll, 1971, 1974b; Carroll and Freedle, 1972; Farr, 1969). An important distinction when considering various measures of comprehension is whether one desires to measure some general comprehension ability of the listener or reader, the comprehensibility of the text for listeners and readers in general, or how much and/or what is comprehended by a specific subject from a specific passage. The response measures that have been used to assess these different types of comprehension have varied considerably.

Those concerned with individual differences in listening and reading comprehension have usually adopted standardized tests and psychometric analyses. In many of the studies reviewed by Kennedy (1971), transfer of listening training to reading was assessed with standardized tests. These tests claim to measure an individual's listening and reading ability at that point in time. However, in selecting a standardized test, an investigator cannot assume that it measures what it purports to measure, but must evaluate the task demands of each subtest (Carroll, 1974a). In most of the transfer of training designs, the emphasis was on tests of general listening and

reading skill. This rationale frequently assumes that listening and reading comprehension are rather homogeneous skills, or even a single skill. With respect to reading, this has been a much debated question (Davis, 1971; Thorndike, 1973-74). M. L. Clark (1972) presents an excellent review of the literature relating to this issue. If listening and reading comprehension refer to a unitary process, then there should be a high correlation between standardized tests of each. Across 23 studies reviewed by Duker (1965) and 12 additional ones reviewed by Kennedy (1971), correlations between scores on listening and reading tests ranged from .45 to .82 and the distribution was not skewed in either direction. However, even viewed with caution given the variety of tests, procedures, and subjects, there still remains a substantial proportion of variance that is unaccounted for and which may reflect differences between listening and reading comprehension processes.

Weaver and Kingston (1971a) have used standardized test data in a somewhat different psychometric analysis. If listening and reading comprehension involve the same processes, then test scores of different aspects of both should fall together when compared. In two separate studies, Weaver and Kingston applied a construct discriminant-validity analysis (Campbell and Fiske, 1959) to several measures of listening and reading comprehension. The measures were paired for construct similarity across oral and written language forms. The major discriminant of the tests, however, was between oral and written forms rather than among common constructs. There is apparently more commonality within a comprehension mode than between supposedly common constructs.

Experimental studies have typically used a measure of comprehension that relates directly to the specific material. Immediate free recall has sometimes been used to measure comprehension (Horowitz, 1968; Horowitz and Berkowitz, 1967; Larsen and Feder, 1940), but one is faced with the difficulty of scoring the recall. Whether one scores the protocols for verbatim repetition or for recall of "meaning" has clear implications for how one conceives of the comprehension process. People do not usually listen or read to retain what they

hear or see word-for-word, but instead assimilate the meaning of the material to their prior knowledge (Bartlett, 1932; Bransford and Franks, 1971; Sulin and Dooling, 1974). Hence, placing demands for verbatim recall on the subject may alter his processing of the material, or at the very least, underestimate the amount comprehended. Another recall method is to probe the subject with pictures (Tatham, 1970) or with questions, frequently of the multiple-choice type (Corey, 1934; Jester and Travers, 1966; Oakan et al., 1971; Sticht, 1968; Young, 1973). One is then faced with the question of what aspects of the text to probe. A criticism of both of these methods is that they require some delay, however brief, before recall. Although comprehension may occur prior to storing the material in memory (even this may not be always the case, particularly with a demand for verbatim recall: Glucksberg and Danks, 1969), the results may reflect retrieval differences rather than comprehension differences.

What is needed is a measure of comprehension that is taken simultaneously with input, so that as the subject is processing the input his comprehension is more-or-less continuously monitored. Unfortunately, most of the "on-line" measures of comprehension measure only the difficulty or complexity of processing at that point in the text rather than how much or what is comprehended. One exception to this generalization is the cloze procedure as used, for example, by DeVito (1965), Portnoy (1973), and Kennedy (1971; Kennedy and Weener, 1973). The better a subject is comprehending a passage, the greater the probability that he will be able to supply the correct word. The major problem with a cloze task is that it disrupts the reader's (and the listener's) normal processing. If he must stop every five to ten words and guess a word, then he cannot be said to be reading naturally.

A final issue with respect to the response measure used is whether the response mode is the same or different from the presentation mode and/or the production mode. To the extent that listening and reading reflect a unitary process, then there should be no cross-modal interactions. That is, whether the input comes from listening or reading should not interact with whether the response is oral or written. Horowitz (1968) did find an interaction between presentation mode and response

mode. Free recall in the opposite mode reduced both correctness and amount recalled. However, in a later study (Horowitz and Berkowitz, 1967), the interaction was not nearly so clear. A complicating factor in this rationale is that it assumes some sort of isomorphism between comprehension and production. Differences may be the result of a failure of production to reflect comprehension rather than true modality effects, but finding an interaction is suggestive of differences between the two modalities.

Auding and Reading: A Model and A Review

Sticht and his associates (Sticht, Beck, Hauke, Kleiman, and James, 1974; Sticht and James, in press) have considered explicitly the question of the relationship between auding and reading and have proposed a developmental model of all languaging processes. Unlike other investigators, they did not bury the assumption of a unitary comprehension process, but incorporated it as a central feature of their model, and then reviewed evidence for and against it. Since they arrived at a different conclusion about the available evidence, I discuss their model and the support they review in detail. Only because they were so explicit about their position is this discussion possible.

The developmental aspect of the model is represented by the successive specialization of basic adaptive processes through interaction with the environment. Listening and looking develop out of the basic adaptive processes of hearing and seeing; uttering and marking grow out of basic motor movements. Then the languaging processes emerge—auding and speaking grow out of listening and uttering respectively, and finally reading and writing develop from looking and marking. All of these changes develop from the child's attempts to adapt to, interact with, and control his/her environment.

The languaging processes—auding, speaking, reading, and writing—work in short-term memory and are connected to a cognitive content store in long-term memory by a single, unitary conceptualizing process.

> The receptive languaging components [auding and reading] serve to transform verbal or printed displays into non-language conceptualizations which constitute the meaning of the message to the receiver. The conceptualizing process continually merges input from the languaging process with information from the cognitive content store to build the subjectively experienced, meaningful message... Auding and reading are considered to be similar processes because both require the use of language and languaging, and because, with identical messages, both result in the formation of a single, mutual internal conceptualization.... To state it concisely, auding and reading differ primarily in the manner in which the individual receives the stimulus words; they are both similar in the sense that they are both receptive communication acts that require a central language and conceptualizing base [Sticht et al., 1974: 17-18, 68, 70].

The model leads to two basic assertions about the development of languaging competency:

> (a) competence in languaging by auding precedes competency in languaging by reading; (b) *when acquired*, reading utilizes the same cognitive content and languaging competencies that are used in auding, plus the competencies involved in searching the visual display and, at least initially, decoding print to speech [Sticht et al., 1974: 71, italics in original].

Sticht et al. derived four hypotheses from the model and these two basic assertions. They evaluated these four hypotheses in terms of the existing literature on auding (listening) and reading and find support for all four. This support led them to a strong conclusion in favor of their developmental model, in particular the unitary nature of auding (listening) and reading comprehension. "The confirmation of each of the four hypotheses provides evidence for the developmental model of reading. Reading is based upon, and utilizes the same conceptual base and languaging competencies used in auding, plus the additional competencies used in converting the visual display into an internal auditory display" (Sticht et al., 1974: 115-116). Let us consider the four hypotheses and the evidence they review.

Hypothesis 1. "Performance on measures of ability to comprehend language by auding will surpass performance on

measures of ability to comprehend language by reading during the early years of schooling until the reading skill is learned, at which time ability to comprehend by auding and reading will become equal" (Sticht et al., 1974: 71). Sticht et al. found 44 studies relevant to this hypothesis, of which they were able to examine only 31. When these studies were divided by grade level, they yielded 71 comparisons of auding and reading. Although Sticht et al. note several potential methodological problems with these studies, all comparisons were retained and weighted equally. Treating each comparison as a separate data point, they found that the percentage of comparisons in which auding was better than reading declined from 100 percent at age 3½ to about 20 percent at college/adult. On the other hand, the percentage of comparisons in which reading was better than auding increased from about 3 percent at age 6 to about 45 percent at college/adult. This interaction supports the hypothesis.

One problem with this analysis, however, is that, although the hypothesis is derived from the model, there are few plausible models that would not predict exactly the same results simply by virtue of the fact that reading is typically acquired later than auding. Imagine a completely separate, dual process model of auding and reading. Auding is acquired during the preschool years; reading is taught *de novo* beginning in first grade. Assume there is no dependence between the two skills. If so, auding would test better than reading in the early years, but as the child begins to acquire reading, the scores on the reading test would pick up and perhaps eventually pass the scores on the auding test in some cases. Nothing in the evidence for this hypothesis says anything about the underlying processes.

Second, the "box-score" methodology gives equal weight to both good and poor experiments (Gardner, 1966). One should accept the conclusions of one well-designed, carefully executed study rather than the total weight of many experiments, each of which is flawed. It is possible that the various faults of each experiment might cancel one another and that the "average" results would thereby be unaffected. However, the reverse is more likely. Investigators may have committed many of the same errors.

Hypothesis 2. "Performance on measures of ability to comprehend language by auding will be predictive of performance on measures of ability to comprehend language by reading *after* the decoding skills of reading have been mastered" (Sticht et al., 1974: 71-72, italics in original). Two hypotheses are embedded here: one is that tests of auding and reading comprehension will show a substantial correlation in older children and adults and another hypothesis is that this correlation will be low in children who are in the process of acquiring decoding skills.

Although Sticht et al. discovered no "ideal" test of this hypothesis, studies by Loban (see references in Sticht et al., 1974) in aggregate are a close approximation. Loban compared children longitudinally from grades four through eight on an oral vocabulary test and teacher ratings of oral language skill with the results on standardized reading achievement tests. The contingency coefficients between oral language and reading achievement increased from .36 in grade four to .52 in grade eight. Sticht et al. also tabulated 27 additional studies that reported a total of 125 correlations between auding and reading tests at various grades one through twelve and college/adult. The mean correlation across studies rose from .35 in grade one to a fairly stable plateau of .60 by grade four. This plateau is probably an asymptote close to a ceiling established by the reliabilities of the tests. Both aspects of the hypothesis thus were supported.

Since there were many differences among the studies in terms of tests used, administration conditions, response tasks, timing, and format, the correlations are not comparable as interval data and the computed means are not valid descriptors of the psychological relationships. In addition, this analysis diluted good studies by mixing them with faulty ones. Each study should be evaluated and considered on its own, not as aggregated with diverse experiments.

Hypothesis 3. "Performance of measures of rate of auding and rate of reading will show comparable maximal rates of languaging and conceptualizing for both processes, assuming fully developed reading decoding skills" (Sticht et al., 1974: 72). The maximal reading rate with relatively complete retention is about the maximum auding (listening)

rate it is possible to attain with compressed speech. Although there are undoubtedly individual exceptions, about 300 words per minute seems to be a common limit when complete comprehension is maintained. Sticht et al. attributed this limit to the bottleneck due to languaging and conceptualizing the information. Since these processes are the same for both auding and reading, the maximum possible rate should be the same, and indeed it is.

The conceptual support the confirmation of this hypothesis adds to the model is limited, however. A bottleneck at only one point in a long and complicated process would be sufficient to establish an upper limit on rate. Processes before and/or after a bottleneck might be the same or different for auding and reading, yet a single bottleneck in common could produce these results. Assume, for example, that the process of integrating word meanings with syntactic structure is the same for both listening and reading, but that lexical access of the mental dictionary is different because of the different modes of input. If syntactic-semantic integration is slow relative to lexical access, then the difference between the two lexical access processes would not be evident in the limits on comprehension rates. Thus, the specific languaging components that lead to the common maximum rate must be specified for this finding to provide support for the model.

Hypothesis 4. "Training in comprehending by auding of a particular genre (e.g., 'listening for the main idea') will transfer to reading when that skill is acquired. Conversely, once reading skill is acquired, new cognitive content learned by reading will be accessible by auding" (Sticht et al., 1974: 72). Sticht et al. identified 12 valid studies that measured transfer of auding training to reading, but no studies that tested for the reverse transfer of training in reading skills to auding. Ten of these reported significant improvement in (transfer to) reading and two showed no transfer.

The transfer design can be an effective analytic tool because specific components of the auding process can be trained to determine which ones transfer to reading comprehension and which do not. Using this rationale, Sticht et al. identified those factors that led to positive transfer. They concluded that "generally speaking, the studies reporting

significant transfer are characterized by a fairly high level of correspondence between auding training and reading transfer measures" (Sticht et al., 1974: 112). This conclusion does not provide strong support for the model, however, because it attributes the positive transfer results to specific transfer related to the particular test instrument rather than to facilitation of the reading comprehension process itself.

In conclusion, the developmental model of auding and reading proposed by Sticht et al. may be correct when adequate data have been collected. It is consonant with the assumptions of numerous investigators and is compatable with conclusions derived from cognitive psychology and experimental psycholinguistics (cf. Glucksberg and Danks, 1975). However, the evaluation of the model was "overly ambitious" (Clark, 1975: 691). Some of the hypotheses derived from the model are not unique to the model, but are compatible with other assumptions about the relationship between listening and reading.

A Task Analysis

What conclusions can be drawn from the evidence? Although the data are varied and uneven in quality, neither the unitary nor dual view is apparently correct in the extreme. The comprehension process is not so robustly unitary nor so decidedly dual that one position rings clear no matter what test or design is used. There simply is not enough evidence from experiments that have a clear rationale, adequate procedure, and decisive results to support a strong conclusion on either side of the issue. In most of the studies, the dependent measure of comprehension was how much was comprehended, recalled, etc. Even if exactly the same results were obtained in the listening and reading conditions, there is no assurance that the processes producing those identical results were the same. Likewise, it would be possible to have the same basic comprehension process for both listening and reading and yet find different results caused by interactions with superficial performance factors. Experiment after experiment, all of which yielded the same basic pattern of results, would tend to be confirmatory. The key strategy is to design experiments that permit the isolation of various components. The compre-

hension process or processes can then be modeled as a function of the various tasks used to isolate the components.

How does an investigator proceed in such an instance? One cannot simply look for overall differences between listening and reading presentation modes and conclude that these differences reflect different comprehension processes. The underlying comprehension processes are complex cognitive events that are not amenable to direct observation. The solution is to systematically vary factors that apparently influence the comprehension process in some non-trivial way. Then, if listening and reading input modes show the same pattern of results, regardless of overall differences, the components influenced by that factor can be supposed isomorphic for listening and reading. If, on the other hand, the manipulated variable interacts with presentation mode, then a point of difference between the listening and reading processes has been uncovered.

Listening and reading conditions are variables that set a different task before the subject, at least in the intial processing stages. The question addressed in this chapter is whether the different tasks involved in listening and reading extend into the comprehension phase. One way to approach the problem is to analyze the task demands imposed by the particular situational conditions. Precisely this strategy has been followed at the decoding level. When necessary differences in listening and reading decoding processes are claimed to result from differences in the availability of the stimulus (transient for speech, durable for print), evaluation of the demands placed on the subject by the task are what lead to that conclusion. The availability of print can be reduced to approximately the duration of the speech stimulus, but in doing so the reader's task has been changed. However, even by examining his performance under these atypical conditions, we may gain insight into the reading process and the importance of a durable stimulus. Neither listening nor reading is a fixed process that is activated the same way in each situation. Listening and reading represent orientations that set the subject to devise strategies for processing speech and print inputs in a meaningful way. The question of

listening and reading comprehension boils down to whether the same comprehension strategies are devised for each input modality.

The implicit task for the subject is defined not only by input mode but also by other situational factors. These factors must be evaluated in terms of whether they induce different comprehension strategies for listening and reading. Let us consider several variables as examples and see how they might be manipulated in this type of analysis. It would not be feasible to vary all these factors in a single experiment. Such an attempt would result in too complex a design to actually test. However, the primary interest is in how these variables interact individually with listening and reading.

Besides the task orientation implicit in listening or reading, the instructions to the subject affect the kinds of comprehension strategies the subject engages in. If he expects to be tested with verbatim recall of a paragraph, he will more likely engage in rote rehearsal than if he expects to be tested only for memory for gist. This difference in expectancy may very well interact with listening and reading presentation modes because the reading task is more amenable to a rote rehearsal strategy since print is continuously available. Unfortunately, many studies do not instruct the subject about what his comprehension test will be. It is left to his imagination or prior experience in such testing situations. Lacking instructions, subjects will formulate their own criterion of what information is important, perhaps on the basis of prior questions (Rothkopf, 1974; Rothkopf and Bisbicos, 1967), thus leading to large individual variation in comprehension strategies. The kinds of processing strategies induced by the particular comprehension tests should be analyzed so that the results can be interpreted in terms of the task demands.

Just as the expectations the subject has about what he will have to do with the information influences the processing strategy, so various aspects of the presentation itself also may affect his strategy. For example, if one varies the input rate, functions from slow to fast listening rates can be compared to functions from slow to fast reading rates. However, for a given

objective rate, the typical reader will have more functional processing time than will a listener. Relative rate may be more critical than absolute rate. If so, a comparison of the shapes of the curves will be more informative than comparisons at strictly equivalent objective rates. Even then, rate may interact with listening and reading. At very fast rates it may be easier for a reader to develop a relatively efficient skimming strategy, searching for the most useful information for constructing an integration of the passage. A listener, of course, does not have such an option available.

The other two classes of factors—language materials and subject characteristics—may also lead to variation in processing strategies. As an example of the former, listening and reading conditions may yield equal comprehension with frequent vocabulary, simple syntactic structure, and a linear conceptual organization of a paragraph. However, reading may have a distinct advantage when the vocabulary is unusual, the syntax complex, and the conceptual organization is hierarchical. These differences in language materials may lead listeners and readers to adopt different comprehension strategies. When reading a novel versus a critical commentary on that same novel, the processing strategies may differ. The same may hold for listening to a play versus an academic lecture on drama. Do the differences in processing strategy resulting from linguistic variation interact with listening and reading input modes? In some situations, there may be more commonality in comprehension strategies between listening and reading than there is within either listening or reading in other situations.

Finally, all of these factors may interact with age. Of all the factors considered here, age is probably the most critical outside the laboratory and it certainly is paramount in the schools. In a task analysis, there are two levels at which age-related factors can be influential. One is basic acquisition. Has the child acquired the information processing skills necessary to handle the information he is receiving? Obviously, a kindergartner who can only recognize letters cannot read. Likewise, a second-grade child who has not learned some of the more complex syntactic constructions (Chomsky, 1969, 1974; Palermo and Molfese, 1972) will not be able to comprehend them

either by listening or by reading. At another level, however, a younger child may not have had sufficient experience devising strategies for efficient information processing. Young children may not know how or may not realize that it is important to devise processing strategies to meet the demands implicit in the task set before them. Since the other variables mentioned—listening/reading, comprehension tests, presentation rate, linguistic and conceptual complexity—define the task for the subject, skill in interpreting these demands and recognizing one's competencies and the available strategies may be major accomplishments for the child. (See Kreutzer, Leonard, and Flavell, 1975, for an examination of children's awareness of memorial strategies.)

The point of these examples is that it is possible to analyze task demands and to tap the underlying processes the listener/reader devises. If there are separate listening and reading comprehension processes, then interactions will result in different patterns of results. If there are no interactions, then perhaps listening and reading comprehension processes are the same. The unitary view does have a special problem, inasmuch as it is basically a null hypothesis. If the comprehension process were unitary, the best research strategy would be to show that any differences obtained between listening and reading were due entirely to decoding differences.

In conclusion, to draw this chapter full circle, a task and process analysis of listening and reading comprehension can provide a more precise notion of what should be attempted in the classroom with respect to teaching reading comprehension. If there are no fundamental differences between listening and reading, then a general language experience approach including both listening and reading would be sufficient. If, however, differences between listening and reading appear in one or another comprehension task, then training on that task would be appropriate. If there are vocabulary differences, then practice on vocabulary that is typically used in reading should be implemented. If there are syntax differences, then systematic introduction to the differing structures could be developed. If there are differences in the organization of ideas, then how written paragraphs are structured in contrast to conversation

or speeches should be added to the curriculum. In any case, suggestions more specific than such global conclusions as "one must teach reading comprehension" or "training in listening facilitates acquisition of reading" could be advanced. If one understands the underlying processes, then applied proposals can be not only more accurate, but also more specific. The research suggested here only answers "whether" and "how" listening and reading comprehension are related, but will not provide an answer as to the best program to implement that information. Additional experiments on how to transfer the knowledge gained through basic research to the classroom still will be needed.

Postscript

Several recent studies have raised the main question addressed in this chapter—whether the comprehension processes involved in listening and reading are the same or different—from the level of an assumption that is accepted as true to a hypothesis that can be tested empirically. These studies approach the question in a variety of ways and bear on a number of issues raised in this paper. However, with one exception to follow, these studies are not discussed, but are listed for the interested reader: Carver (1976), Cocking and Potts (1976), Goldman (1976), Neville and Pugh (1974, 1976-77), Perfetti and Goldman (1976), Sticht (in press), and Walker (1975-76).

An experiment reported by Mosenthal (1976-77) used the task analytic rationale for comparing oral and silent reading comprehension with listening comprehension. Mosenthal first assumed that H.H. Clark's (1969a, 1969b) theory of linguistic comprehension is essentially correct. Clark postulated three principles that operate in sentence verification tasks and which have been confirmed in numerous experiments by Clark and others (H.H. Clark, 1974). Mosenthal reasoned that testing whether or not Clark's principles operated identically in oral and silent reading as they did in listening would provide an adequate comparison of listening and reading comprehension processes. A straightforward statistical comparison is not strictly necessary although Mosenthal was able to perform

such a comparison. Since Clark's principles describe components of the underlying comprehension process, confirmation of the principles and their identical manner of operation in listening and reading tasks would permit the conclusion that listening and reading comprehenion processes are identical. If the principles were not confirmed in both tasks, then the processing component described by that principle could be said to be different.

Using Clark's basic syllogistic reasoning task, Mosenthal tested second and sixth grade children for the operation of Clark's principles. In one experiment he compared oral reading with listening and in two additional experiments he compared silent reading with listening. In the first experiment, there was a significant decrement in the overall level of performance from listening to oral reading, but the pattern of results was the same for both modes. In the last two experiments, not only was the pattern of results the same, but there was no difference in the level of performance between listening and silent reading. Mosenthal concluded that silent reading and listening involved the same comprehension processes but that oral reading comprehension was different. Since Clark's principles were confirmed in general in the oral reading task, just as in the listening task, the proper conclusion is that the comprehension process is the same for oral reading as well.

Because Mosenthal used a task analytic rationale, the results of his experiments provide a valid comparison of the comprehension processes underlying listening and reading. One may reject the particular model of comprehension adopted by Mosenthal, but one cannot object to the rationale for the comparison. Based on the research reviewed here, it is unlikely that a direct comparison of listening and reading comprehension is possible. But an indirect comparison is possible as has been demonstrated by Mosenthal.

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Arguments for a Constructive Approach to Comprehension and Memory

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An increasing number of studies in the human memory literature have been interpreted in terms of comprehension and memory being a constructive process. The purpose of this chapter is to explicate and synthesize the vast body of research which has lead many psychologists to find the constructive approach convincing.

The constructive position considers comprehension to be an elaborate process which depends on extra-sentence, as well as intra-sentence context. The constructive process is based on the interaction of the information presented, the context of that information and the existing knowledge schemata of the subject. This conception of memory has been elaborated to various degrees in several areas within psychology. These include: Gestalt psychology (Koffka, 1935; Bartlett, 1932), pragmatism (James cf., 1970; Peirce, cf., 1968; Dewey, 1920, 1931), and more recently, contextualism (Jenkins, 1973, based on Pepper, 1942), constructionism (Piaget, 1970; Cofer, 1973) and assimilation theory (Bransford and Franks, 1971).

The chapter discusses five topics regarding constructionism: 1) the word as a unit in language processing, 2) semantic prerequisites for comprehension, 3) integration of information in memory, 4) memory for original input, and 5) inferences formed from material presented. These topics highlight facets of the significant effect of context dependence on constructive memory. Context dependence refers to the relationship between the material presented and the linguistic and situational setting in which it is couched (cf. Frederiksen, 1975).

The Word as a Unit in Language Processing

The first property of the constructive theory of memory to be discussed is that words do not have fixed meanings and

thus cannot be considered to be stable units of language. This view accepts that numerous meanings may be attributed to individual words but contends that for any one of these classes of meanings the range of meanings and the appropriate meaning, specifically, are determined by the context of the word rather than by the absolute nature of the word alone. For example, the word *can* can mean a small receptical for liquids, a trash container, a prison cell, etc. But even within any one of these classes of meanings, the context in which the word is presented determines the range of possible meanings (e.g., "kick the can", "can of deodorant", "toss me a can of beer", "crushed can", etc.).

This view was expounded by Pepper (1942) as well as others more recently who contend that experiences consist of unambiguous "events" and are preserved in memory as such rather than as words. Events are subunits of experience which are characterized by the fact that although they can be disected into components, they derive their meaning wholistically from the interaction of the experimenter with the experience and the setting of the experience, i.e., the context of the event. In reference to linguistic experiences, the event, being a perceived unit, does not necessarily correspond to grammatical or word boundaries; nor is the meaning of an event constant in different contexts. This is because the meaning of an event can be derived from an accompanying gesture, a previous topic, presumed common knowledge, etc.

It is in part due to the realization that linguistic analysis alone is insufficient to analyze intended meaning, that linguistic theories of semantics have withdrawn from equating words with their reference and cognitive theories of semantics have emerged. Reference refers to the specification of the meaning of words in terms of the objects or events they are concerned with. One obvious reason why meaning cannot be equated with reference is because a single referent may be labeled by many words, depending on the context—a particular woman may be a doctor, a driver, a mother, an animal, an idol, Sue, etc. In other words, word meaning is more than reference. Another reason, more to the point of this chapter, why equating word meaning with referent is inaccurate is because the choice of words in a sentence is more a function of

the speaker's knowledge and the environmental context than it is a function of syntactic or semantic selection restrictions (Ortony, 1973). Also, from the listener's point of view, the meaning attributed to a sentence is as much a product of extra-linguistic variables as it is a product of the specific words used. The perception of a referent is a cognitive process, not a linguistic one. For example, consider the "ambiguous" sentence provided by Katz and Fodor (1963),

The stuff is light.

The sentence is ambiguous because "light" may refer to color, weight, level of involvement, etc. One way to disambiguate the sentence would be to linguistically elaborate the sentence,

The stuff is light enough to carry.

However, the same effect can be achieved simply by having knowledge of context; if one person offers to help another person carry his groceries and hears the original sentence, the meaning is unambiguous. In other words, judging a sentence to be ambiguous or unambiguous may depend more on perceived (extra-linguistic) context than on linguistic knowledge. Perhaps, too, anomalous sentences are more a function of the limits of experience or imagination than incompatible semantic components. In reality, anomally seems to be more related to (real or imagined) knowledge of the referent, than to the markers on the lexical items in the mental dictionary. Are the following examples anomalous?

The honest snowball...
The flying horse...
Colorless green ideas...

(See Olson [1970] for the development of a theory of reference in terms of a cognitive theory of semantics.)

What evidence is there that words do not have fixed meanings and thus that words cannot be considered stable units of language comprehension?

Several studies support the notion that words do not play a static role in our language and that the context and thus the meaning of a word is affected by the learning strategy of the subject at the time of encoding. Hyde and Jenkins (1969) presented subjects with word lists and instructed them to use different strategies for learning. One group received compre-

hension instructions. Their task was to rate each word as being pleasant or unpleasant. Another group was instructed to use a formal task. This task was either to estimate the number of letters in each word or to decide if the letter *e* were present in each word. Thus, all subjects were presented the same words, but the context of the words was varied by the instructions. The question of interest was, did the change in contexts resultingly change the nature of the events in memory? The results were that the comprehension group recalled the words at a higher rate and showed a higher degree of associative clustering than the formal group. A control group of intentional learners who performed no orienting task, surpassed the formal group but not the comprehension group in recall and associative clustering. These results were maintained even when the presentation duration was doubled and the list was presented twice before recall. Similar results have been reported by Hyde, 1973.

An alternative explanation of these data is that the comprehension task facilitated recall of the word list by highlighting intra-list associates. However, in a comparable study, Hyde and Jenkins (1973) included lists of both related and unrelated words. In both types of lists the task requiring comprehension resulted in a recall level twice as high as that resulting from the tasks not requiring comprehension.

Elias and Perfetti (1973) controlled word encoding and measured the effect on later recognition memory. Word encoding was directed by instructing subjects to simply learn a list of words or to produce rhymes, synonyms, or associates for each word. When the recognition test items consisted of original words and associative distractors, the general order of performance reflected superiority of instructions encouraging a semantic focus.

The results of these studies indicate that learning strategies (tasks) are part of the context and thus affect the processing of words. Further, these processed units, rather than the originally presented material are stored in memory. Mistler-Lachman (1972, 1974) and Rosenberg and Schiller (1971) have provided additional evidence for the relationship between learning strategies and comprehension using sentences rather than individual words.

Another way in which altering the context of individual words can be shown to affect the meaning attributed to the words is demonstrated in studies where words are provided context by the sentences in which they are embedded. Anderson and Ortony (1973) presented subjects with a series of sentences, followed by cued recall for the sentences. The cues for each sentence were chosen to be effective or ineffective for retrieval of the sentence, depending on the assumed mental representation of the original sentence. For example, some subjects saw the sentence,

The container held the apples.

The other half of the subjects saw,

The container held the cola.

The corresponding cue for the sentences were *basket* and *bottle*, exemplars of the word, *container*. If it were the case that the mental representation of the word *container* were not context-dependent then it would be predicted that the cues *basket* and *bottle* would be equally effective. On the other hand, if comprehension of the original sentence involved constructing a particularized and elaborated mental representation, then the effectiveness of each cue would depend on the details of the mental representation, i.e., *basket* would be a better cue for the first sentence, and *bottle* would be a better cue for the second sentence, despite the fact that the original sentence had the same subject, *container*. A significant effect of type of cue was reported in the direction predicted by the context-dependence hypothesis; cues close to the meaning of the original sentence were more effective than remote cues. Tulving and Thomson (1973) have discussed similar results as examples of encoding specificity, where the context ("cognitive environment") affects the access routes to the stored information. Similarity between encoding access routes and retrieval access routes consequently facilitates retrieval.

A second experiment in the study by Anderson and Ortony (1973) confirmed and extended the generalizability of the first study. It was suggested in the first experiment that subjects formed particularized mental representations of the sentences because the definite article in the beginning of each sentence implied that the sentence was predicating something

about a specific thing, event, or person. Thus, in the sentences in the second experiment, the subject nouns were general terms. Subjects were presented sentences from fourteen sets of four sentences each. One four sentence set was the following:

a. Nurses are often beautiful.
b. Nurses have to be licensed.
c. Landscapes are often beautiful.
d. Taverns have to be licensed.

When cued with *actress*, sentence A was the target sentence; B was the subject control sentence; C was the predicate control sentence; and D was a double control sentence. When the cue was *doctor*, then B was the target sentence; A the subject control; D the predicate control, and C the double control. The following predictions were confirmed by the results. First, the probability that a certain cue allowed the retrieval of a target sentence *was greater than* the sum of the probabilities of the cue allowing the retrieval of the subject and predicate of the target sentence. This result supports the notion that the meanings of the individual words in a sentence interact in the process of constructing a mental representation of the sentence. Second, the probability of a cue facilitating the retrieval of either the subject or the predicate of the double control sentence was zero. Had this probability deviated from zero, there would be some doubt as to the construction of a particularized memory at the time of encoding. From the results of this study it is apparent that the mental representation of sentences is not simply the lexical readings of the individual words.

Further evidence of the dynamic nature of words can be found in the speech perception literature. Numerous studies have shown that the context of a sentence functions to set the subjects to perceive the individual words (see Rubenstein and Aborn [1960] for a review of this literature). Miller, Heise, and Lichten (1951) showed that while listening to sentences, subjects successfully used the context of the sentence to predict successive words. Subjects listening to a list of individual words, by comparison, showed little predictive processing. Consequently, words presented in a sentence context were

perceived more accurately than the same words pronounced separately as individual items in a list of test words.

More recently, Leventhal (1973) examined the locus of the set effect of sentence context on word perception. Subjects in this study were presented sentences or individual words and were tested for their accuracy in identifying 1) the initial word of the sentence presented in noise (Post-context), 2) the final word of the sentence presented in noise (Pre-context), and 3) the isolated words presented in noise (Control). The result was a linear positive relationship between word predictability (determined by the context) and intelligibility, such that

$$P(C/\text{Post-context}) > P(C/\text{Pre-context}) > P(C/\text{Control}).$$

In the Post condition, the facilitative effect was attributed to subjects delaying decision about the initial word in the sentence until the entire sentence was encoded. These studies support the notion that to consider words as stable units of language is to ignore the import of extra-linguistic factors on comprehension.

One question raised by the discussion of words as language units is exactly how does context affect the meaning of words? Does context operate by limiting or focusing in on the range of possible meanings of a word or does context operate by enhancing the realization of possible meanings? While this issue remains unanswered, it has been interestingly suggested by Stahlin (cf., Blumenthal, 1970:52-53).

> It hardly needs to be said that individual words must be understood before the sentence-thought can be comprehended. But the important fact is that the reverse relationship also exists; with the majority of words we do not at all arrive at a recognition and assimilation of word meaning separate from sentence comprehension. As soon as the sentence thought is assimilated in consciousness—and the tendency to do this as soon as possible is always there—then sentence comprehension determines the manner in which the individual words are assimilated as parts of the sentence context.

Semantic Prerequisites for Comprehension

The second basic property of the constructive theory of comprehension is that the stored form of linguistic information in memory represents a context-dependent interplay between

linguistic input and prior (possibly extra-linguistic) knowledge. This characteristic of constructive memory suggests more specifically that prior knowledge often provides the semantic prerequisites for comprehension. This view of memory has been suggested by Butler (cf., Blumenthal, 1970:56).

> Given two speakers of the same language, no matter how well one of them structures a sentence, his utterance will fail if both parties do not share the same field to some degree. . . . There are inner aspects of the field, such as an area of knowledge, or outer aspects, such as objects in the environment. . . . The structure of any particular language is largely field independent, being determined by its own. . . rules, but the field determines how the rules are applied.

Bransford and Johnson (1972) tested this hypothesis by comparing the recall of subjects presented a passage without accompanying context with the same passage with accompanying context. The absence of context was controlled for by using novel materials such that the prerequisite semantic information was not likely to be in the subjects' pre-experimental repertory. An example of such a passage (without context) is the following:

> If the balloons popped the sound wouldn't be able to carry since everything would be too far away from the correct floor. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire would also cause problems. Of course, the fellow could shout, but the human voice is not loud enough to carry that far. An additional problem is that a string could break on the instrument. Then there could be no accompaniment to the message. It is clear that the best situation would involve less distance. Then there would be fewer potential problems. With face to face contact, the least number of things could go wrong.

Context was provided by the inclusion of an appropriate picture of a suitor singing at the base of his beloved's apartment building into a microphone attached to speakers which floated on balloons upward to the girl's window. Using

dependent measures of comprehension rating (on a scale of one to seven), and idea units recalled, providing context was found to have a significant facilitative effect. In addition, the group presented the context and then the passage outperformed the group presented the same passage twice (the context 2 group) by twofold. This is strong evidence for the notion that the picture specifically served as a prerequisite setting for comprehending the passage. Further, the context-after group did not recall significantly more than the no context group, suggesting that the superiority of the context effect was not due to facilitating subjects' generation of ideas compatible with the picture. To refute the interpretation of these results as evidence for the importance of providing retrieval cues rather than evidence for prerequisite knowledge, a fourth comparison was included. A partial context picture was derived which contained all of the objects in the appropriate context picture, but the arrangement of the objects was different. The effect of presenting the partial context picture was inferior to that of the context before condition and not significantly different from the context 2 group. Clearly, supplying the picture before presenting the passage provided a context which facilitated comprehension of the novel passage.

Johnson, Doll, Bransford, and Lapinski (1974) followed up this experiment with a study in which subjects read sentences with an appropriate context, inappropriate context, or no context. The materials were presented at a fast (one second inter-sentence interval) or slow (seven second inter-sentence interval) rate. They found no effect of presentation rate when comparing the appropriate context and no context groups. However, the inappropriate context retarded overall recall relative to the no context group with the effect greater at the fast presentation rate than at the slow rate.

Dooling and Mullet (1973) replicated the Bransford and Johnson result in a study in which context was provided using theme rather than picture. By presenting the theme before reading, after reading, or not at all, they provided evidence that the locus of this effect was at input.

The Bransford and Johnson (1972) study demonstrated the importance of prior knowledge in comprehending verbal material by using a novel passage with which it was unlikely

that subjects were familiar. However, several other studies have illustrated that relevant prior knowledge alone is not sufficient to insure comprehension. These studies involve the comprehension of materials where the semantic prerequisites are available to the subjects from their prior knowledge, but these prerequisites are not necessarily activated at the time the materials are presented. Evidence supporting this phenomenon has been discussed by Bransford and Johnson (1973). Anecdotal evidence can be seen in trick sentences such as, *Pas de la Rhone ques nous.* This sentence is usually approached with an inappropriate set, yet is easily comprehended when subjects are told that it is pronounced as the English sentence, *Paddle your own canoe.*

Dooling and Lachman (1971) investigated the role of prerequisite semantic knowledge by manipulating thematic title (absence or presence) and syntactic constraint of the passage (random words, random phrases, or words in a list). The passages were about "Christopher Columbus Discovering American" and "The Space Trip to the Moon." The results were that recall was significantly higher when the topic was presented before the passage as compared with the no topic condition, and that the facilitative effect of topic increased with syntactic constraint. Similarly, Pompi and Lachman (1967) had subjects read verbal passages presented one word at a time on cards. The cards were arranged so as to represent either a syntactically organized paragraph or random order. In a word recognition test that followed, subjects saw old words and new words of which half were high thematic associates to the passage and half were low thematic associates. Subjects tended to falsely recognize highly thematic words which had not actually been previously presented. Further, the difference between the relatively high rate of high-thematic word errors and the lower low-thematic word error rate was greater with syntactic order than with random order.

Another way to manipulate context using thematic idea has been demonstrated by Dooling and Christiaansen (1974) and Sulin and Dooling (1973, 1974). In the later studies, subjects read the same biographical passages and were told that the main character was either a famous person (Adolf Hitler or Helen Keller) or a fictitious person (Gerald Martin or

Carol Harris). It was hypothesized that the subjects who were told that the paragraph they would read was about a famous person would integrate the information in the paragraph into an already existing elaborate mental schema, thus providing information extraneous to the input sentence. This hypothesis was supported by the results. On a sentence recognition test, subjects in the famous person condition were less accurate than subjects in the fictitious person condition, the difference accountable by false positive recognition errors. Further, these errors were thematic; when the test sentence was a high thematic associate, the difference between recognition scores for the famous person and fictitious person was greater than when the test sentence was a low thematic associate. This suggests that recognition of material from a passage describing a person who is already familiar to the subjects draws on knowledge already existing in the mental schemata and resultingly accuracy is affected.

A more subtle type of thematization has been examined in several studies by manipulating recall prompts for sentences. When presented a sentence such as,

The admiral captured the bandit,

the subject noun and the object noun are equally good as recall prompts when the two nouns have equal imagery value, and more important to the point, when the sentence is presented without context (Elias, 1973; Perfetti, 1973; Perfetti and Goldman, 1974; Perfetti and Tucker, 1973). However, when the sentence is embedded in a context paragraph, and the subject noun in the sentence is thematized (i.e., the passage is primarily about the admiral), the subject is superior to the object as a recall prompt. Further, thematizing the object of the sentence improved its effectiveness as a prompt without decreasing the effectiveness of the subject prompt. Thematization is measured by the number of propositions which contain a certain referent. The relative effect of the subject noun and the object noun as recall prompts for a sentence has also been demonstrated by Ehri and Rohwer (1969). By manipulating the syntactic and semantic characteristics of verbs which linked noun paired associates, they found that object related verbs provided less facilitation to later recall than subject related verbs.

Perfetti and Goldman (1973) studied the locus of this effect by manipulating thematization (subject or object), topicalization (active or passive), recall prompt (recipient or agent), and retention interval (fifteen minutes or two days). They found that the agent of a sentence was a better recall prompt than the recipient and that a thematized noun was a better prompt than a noun which had not been thematized. Also, an interaction was reported such that the effectiveness of the agent prompt was not affected by its position in the original sentence (as indicated by active versus passive form), but the recipient was a better prompt when it was in the first noun position in the sentence (passive form) than when it was second. The context of a sentence and the extent to which the context thematizes aspects of the sentence is thus shown to have a significant effect on sentence comprehension.

Context has also been manipulated by the use of various incidental learning tasks and been shown to resultingly affect comprehension. Bobrow and Bower (1969) attempted to explain why subjects who generated a verb to link noun pairs could better remember the second noun when cued with the first than could subjects who were supplied the linking verb. As a result of imposing various conditions on the subject as the noun pairs were presented, the subjects primarily found that the conditions which encouraged the subjects to generate a specific context for each noun pair aided retention of the noun pair. Examples of facilitative conditions are 1) generating sentences to relate noun pairs, 2) distinguishing the meaning of an ambiguous noun on the basis of its context sentence, and 3) providing a plausible continuation sentence from a sentence provided. Their results support the general notion that comprehension improves recall, and, more specifically, since subjects performed better in the generate sentence condition than in the supplied sentence condition, they concluded that the subjects' relation to the context of the noun pairs seems to have had significance to memory. Additional examples of facilitation have been reported as a result of contrasting a group required to supply a sentence mediating paired associates with a group which did not mediate (Jensen and Rohwer, 1963; Rohwer, 1966; Rohwer and Lynch, 1967). Using sentences rather than word pairs, Anderson, Goldberg, and Hidde (1971)

reported somewhat the same result. Subjects who read sentences aloud and had to fill in blanks in the sentences were better able to recall the sentences than subjects for whom the blanks were filled in (e.g., Dictionaries list words in alphabetical _____). Rosenberg and Schiller (1971) compared the recall of subjects who employed an incidental semantic task while learning sentences with subjects who employed an incidental non-semantic task. The incidental non-semantic task involved estimating the number of letters in each sentence as it was presented. The incidental semantic task required subjects to rate the relative familiarity of each sentence. They found that subjects who employed an incidental semantic task while learning sentences, were subsequently able to recall the sentences at a higher rate than subjects who employed an incidental non-semantic task. As previously mentioned, Hyde and Jenkins (1969) found that subjects who employed incidental tasks at the time of input, were required to use word pairs as semantic units and consequently recalled more of the word pairs than subjects who used the words as physical objects. In a similar task using sentences, Mistler-Lachman (1974) found that tasks demanding "deeper comprehension" of sentences facilitated recall. In order of facilitation (from lowest to highest) the tasks which she used were having subjects 1) judge the meaningfulness of a presented sentence, 2) judge if a sentence followed from a given context, and 3) form a continuation sentence.

Kintsch, Crothers, and Jorgensen (1971) also had subjects perform various activities during each short study period following the presentation of three stimulus nouns. Their results suggested that the type of incidental task affects the context and thus the storage of the words in memory. They concluded, however, that it was not the semantic processing of the words per se which facilitated retention in their short-term memory task, but rather the process of successfully "grouping" or "chunking"the words in memory. The "chunking" argument, although consistent with the studies presented which used isolated words as stimuli, seems less appropriate to studies involving memory of sentences or more complex verbal materials.

The studies discussed above have been presented in support of the second major characteristic of constructive memory to be discussed in this paper; that the stored form of linguistic information represents a context dependent interplay between linguistic input and extra-linguistic knowledge. More specifically, the level of comprehension, as manipulated by thematization, incidental task, etc., can provide a variable context for any given linguistic material being learned.

Integration

The third characteristic of constructive memory is that subjects combine isolated ideas into more integrated ideas in memory, and the resulting integrated ideas are qualitatively different from the isolated ideas, not just more complicated. On another level, this notion has been expressed in the statement that the total is more than the sum of the parts. There are two ways of looking at this qualitative difference between the simple ideas input and the integrated ideas stored in memory. First, a subject, when presented linguistic information, seldom treats the material simply as objects to be remembered. Convincing evidence suggests that subjects do not appear to be only storing the surface structure (Bregman and Strasberg, 1968; Honeck, 1971, 1973a; Sachs, 1967a, b) or even the deep structure (Bransford, Barclay, and Franks, 1972; Bransford and Franks, 1971) of individual sentences. In general, at the time of input, subjects draw on a broad range of world knowledge and spontaneously integrate the information, making inferences and assumptions about the individual ideas presented.

A second way of looking at the differences between the isolated ideas presented and the integrated ideas stored can be seen as a part-whole relationship, to some extent similar to the fundamental principle of Gestalt psychology. This principle is basically that perception of the whole takes on "emergent properties" which transcend the properties of the parts. These emergent properties represent aspects of a psychological organization which tends to develop in the direction of a stable, wholistic mental organization. To the point of this chapter,

this suggests that complex linguistic materials convey qualitatively more information than is expressed by any of the component parts.

This relationship between linguistic part and whole is also strongly suggested by a characteristic of constructive memory mentioned earlier, that comprehension determines the quality of events in memory. The notion that subjects treat linguistic information as cues to activate and modify mental knowledge structures, rather than simply as information to be stored (e.g., the "reappearance hypothesis," cf. Neisser, 1967) clearly suggests that what is stored is thus qualitatively different from what is input. The mental representations of objects become richer as the environment and one's knowledge are enhanced. Piaget (1973:1), who has dedicated his life's work in psychology to studying epistomology from this perspective, contends that,

> Moreover, perception is invariably extended by interpretations based on assimilation to the sensorimotor, conceptual, preoperational or operational schemata, and it is obvious that rememberance must impinge on these interpretations or significations, no less than on the antecedent perceptions themselves.

The tendency of subjects to use the information expressed in individual sentences to form wholistic mental representations which transcend the meaning expressed in the individual sentences, receives experimental support from studies by Barclay (1973), Bransford and Franks (1971), Honeck (1973b) and with children, Barclay and Reid (1974). In the study by Barclay, subjects were presented similarly constructed sentences which randomly described a linear array of five animals, one pair in each sentence. One such sentence was,

The bear is to the left of the mouse.

Half of the subjects (the imagers) were informed that the sentences they would hear described a linear order of animals and that their task would be to figure out the order of the animals. The other half of the subjects, not informed of the general structure of the array, attempted to memorize the sentences. Five minutes after the subjects heard the acquisi-

tion set of eleven sentences, they were presented with an unexpected recognition test. The recognition sentences consisted of true and false sentences which had or had not been included in the acquisition list. The results were that the imagers rated all of the true sentences as "old" and all of the false sentences as "new," regardless of whether they had been previously presented or not. The recognition judgments of the memorizers, however, while being consistently lower than the imagers, depended more on their linguistic similarity to the acquisition sentences than on their "truth value." Since the array was never presented in its exact linear order, but was only described by eleven sentences drawn from the possible set of 25 (five nouns taken two at a time), it can be assumed that the imagers had thus constructed the array mentally. The imagers were using the acquisition sentences as base information from which to form the overall structure of the array. Thus, later comparisons of recognition sentences with the stored representations of the input material resulted in the verification of all test sentences consistent with the constructed image and the rejection of test sentences which did not accurately describe the array.

Another study demonstrating that subjects use individual sentences to construct wholistic representations which are qualitatively different from the sentence input, is that by Bransford and Franks (1971). The task of subjects in this study was similar to that utilized by Barclay. Subjects were presented sentences in the acquisition phase which described various aspects of composite complex sentences in various combinations, and were later presented old and new sentences to recognize. In this study, each complex sentence represented the relations among four simple declarative sentences. The sentences which the subjects were presented were composed of combinations of one, two, or three of the four simple sentences. Thus the number of semantic relations expressed in any one sentence varied. The result of most interest here is the direct relationship between subjects' confidence in their recognition judgments and the extent to which the test sentence exhausted the four simple sentences contributing to the complex sentence. That is, subjects were more confident that test sentences were old when the sentences were

comprised of a greater number of semantic propositions, even when the test sentences were new. These results suggest that subjects were integrating the semantically related information at the time of presentation even though the information had been presented in individual, nonconsecutive sentences. Later recognition was then a process of comparing the test sentence with the integrated information stored and responding on the basis of the extent to which the test sentence matched the memory.

The results of Honeck (1973b) also support the notion that subjects construct and store abstract representations of verbal information at the time of input. Subjects heard several one sentence proverbs, followed later by one supplementary sentence for each proverb. The supplementary sentences were repetitions of the proverb, grammatical transformations of the original (T), parasyntactic paraphrase (P), or unrelated control sentences (U). An example of a proverb and the corresponding sentence conditions follows.

Proverb: Great weights hang on small wires.
T: On small wires hang great weights.
P: Many important things are dependent for their outcome on details, small wires, that is.
U: Wrapping certain packages with small wire is a good idea sometimes.

The test phase consisted of prompted free recall of the proverbs. The proverbs supplemented with parasyntactic paraphrases were later recalled at a significantly higher rate than those in the other three conditions, including proverb repetition. The expanded context of the parasyntactic interpretation seemed to have a facilitative effect due to the redundancy with the conceptual base of the original proverb. The superiority of the parasyntactic condition over the repetition condition strongly suggests that the stored form of the proverbs consisted of the constructed representation rather than an interpretative form more isomorphic with the original.

Memory for Information Presented

The previous section offered support for the notion that information is spontaneously integrated in memory. A logical

consequence of integration is that memory for the original material does not endure. This is the next point to be considered. The fourth characteristic of constructive memory is that once individual language segments are integrated and fused into events, subjects cannot recover the original pattern which had provided support for the construction made.

Bartlett (1932) provided a classic demonstration of this point. Barlett held that in remembering, the subject reconstructs the products of constructive acts of the past. One convincing way in which he demonstrated this quality of remembering was by presenting subjects with a passage from "The War of the Ghosts" and having them free recall it at various intervals after the reading. The general finding was that what endured in memory was a consolidation of the points related to the theme, integrated across sentence boundaries. As the delay of test increased, the amount recalled decreased, usually while retaining the essence of the passage. Bartlett contended that the transformation of the original passage resulted from adaptive and organizational factors operating on the individual items, repeatedly reconstructing the information and incorporating it into a knowledge system. This is how Bartlett explained the fact that the subjects could not recall the original passage, only their constructed version of it.

The nature of what does not endure in memory has been addressed by Sachs (1967a, b). In the second of these studies, subjects heard 28 passages, each interrupted by a bell and then a repetition of a previously heard sentence. The test sentence was repeated either exactly as it had been previously heard, with an active-passive reversal, with a change in the form of the sentence, or semantically changed. The amount of interpolated material between presentation and test was varied from 0 to 160 syllables. The task of the subjects was to identify each test sentence as changed or identical, when changed to indicate whether the change was in the meaning or the form of the sentence and to specify their degree of confidence in each judgment. As would be predicted from the work of Bartlett, the results were that subjects were significantly more accurate in recognizing semantic changes than syntactic changes or identical sentences, as the lag increased. Results of Perfetti and Garson (1973) confirm those of Sachs

using lag times varying from four minutes to one week. These data support the notion that subjects transform information very shortly after presentation and that the nature of the transformation is related to the meaning of the material. Once the construction has occurred, however, subjects do not have access to the original material.

The notion demonstrated by these examples, that is that once individual segments are integrated into wholistic units, the segments are not retained, receives support from numerous areas in psychology. Posner and Keele (1968) presented subjects with randomly constructed dot patterns followed later by a recognition test. The stimulus set was composed of three prototype patterns and four distortions of each prototype. In the presentation phase, subjects were presented only the patterns specified as the distortions, and were instructed to classify the patterns into three categories. Subjects were informed whether each response was correct or incorrect. In the second phase of the experiment, subjects were shown several patterns and were asked to sort them into the three categories again. The patterns were old distortions, prototypes (not previously seen) and new distortions. The old distortions were classified with 87 percent accuracy. The prototypes were classified with a significantly inferior accuracy of 73 percent. Since the distortions were recognized at the same level of accuracy as the prototypes which had not been previously seen by the subjects, it was suggested that the enduring mental representation of visual patterns is in the form of an abstraction of the exemplar patterns. When the retention interval was extended to a period of one week (Posner and Keele, 1970; Strange, Keeney, Kessel, and Jenkins, 1970), recognition accuracy for old distortions decreased considerably, while memory for the prototypes declined only slightly. This demonstrates the stability in memory of the abstraction despite the fading memory for the individual exemplars from which the abstraction derived.

Using line drawings of faces for stimuli, Reed (1970) reported similar recognition results. The faces were differentiable on the basis of four characteristics—nose length, mouth position, distance between the eyes, and the height of the forehead. In the first part of the experiment, subjects classified

the pictures into two categories. Results suggested that while classifying the pictures, subjects tended to abstract a prototype to represent each category and then classify each test item on the basis of its similarity to the two prototypes. Later recognition rates were higher for the prototypes (which subjects had never seen) than for control items.

Similarly, Esper (1925) trained subjects to label items in a systematically ordered color-form matrix. Later recognition indicated that the subjects had abstracted the system of the matrix but had little memory for the specific instances that had previously been presented, despite the fact that subjects had seen each of the instances several times. Studies by Segal (1962), Foss (1968), and Keeney (1969) have found similar results. The indication of these studies is that with a limited set of individual items to learn, subjects can retain memory for the items. But with a large set of items, the (adaptive and economical) learning process seems to be to abstract the pattern or system of the instances, thereby losing the capability to discriminate instances presented from acceptable instances in the system. This is termed an adaptive process because given the limited capacity of long-term memory, it is more adaptive for a person to remember a generalized system (from which particulars can be generated) than to remember seven plus-or-minus two (Miller, 1956) of all of the possible acceptable particulars.

The evidence above supports the notion that integration of instances into abstract systems is a common memory strategy. More specifically now, two qualities of integration in memory will be discussed. The first of these is that integration occurs on the basis of semantic import and relatedness, regardless of temporal proximity. This was demonstrated in the previously discussed study by Bransford and Franks (1971). In that study, subjects in the first part of the experiment were presented 24 acquisition sentences arranged so that in each successive sequence of four sentences there was one sentence from each of the four base idea sets. Despite the fact that each sentence was separated from the next semantically related one by at least four sentences with an intervening task following each sentence, results indicated that integration of the separate but semantically related sentences did occur. This

aspect of their data has been discussed elsewhere (Bransford and Franks, 1970).

Sulin and Dooling (1974) in an extension of their previous (1973) experiment, reported that subjects reading a prose passage about a famous person performed less well on a later recognition test of the sentences presented, relative to recognition test scores for a passage about a fictitious person. In addition, the inferior recognition scores of the famous person passage further decreased and thematic intrusion errors increased as the retention interval increased (from five minutes to one week). The subjects were apparently integrating the information in the famous person passage into a previously established knowledge base for that person and the congruence with prior knowledge increased over time. In other words, the fact that the two sources of information (prior knowledge and the passage) were greatly separated in time did not seem to interfere with their integration.

The second specific quality of the integration process in memory is that this fusion of ideas into integrated units is based on the appropriateness of the integration process to the items involved. Consider the following four sentences:

1. The first man on the moon became a national hero.
2. Neil Armstrong has several children.
3. The first man on the moon has several children.
4. Neil Armstrong became a national hero.

In most imaginable contexts, it would be considered appropriate to integrate only sentences (1) and (4), and (2) and (3). the description of Neil Armstrong as "the first man on the moon" is inappropriately matched with "has several children" as is the name "Neil Armstrong" inappropriately matched with "become a national hero" in the general context. The test of appropriateness is that the semantic connection between the description-subject and the predicate is closer than that between the name-subject and the predicate and vice versa. This relationship is taken up in more detail by Ortony (1973). Ortony and Anderson (1974) used materials such as those above and demonstrated subjects' ability to perceive "appropriateness." They presented subjects with 32 sentences from a

set of 16 quadruples like the one above. Following this was a recognition test on the full set of 64 sentences. The results confirmed the appropriateness of use hypothesis anticipated. Incorrect rejections were most often of sentences involving inappropriate uses, and false alarms tended to be of sentences involving appropriate uses. The subjects tended to encode and then integrate the sentences in the semantically most acceptable way.

Inference

The fifth and final characteristic of constructive memory, following from the proposition that comprehension is context dependent, is that logical inferences are commonly made from information presented. "Inference" refers to information which is based on what is presented but is a continuation or extension of the original input. The constructive theory of memory argues that comprehension involves more than concretizing or simply preserving what is input, and consequently subjects have substantially more information at their disposal than is actually presented. This additional information can often be described as logical inferences of the original material.

Evidence for spontaneous and induced production of inferences comes from numerous sources. The previously discussed study by Barclay (1973) reported that subjects inferred the order of a linear array of five animals when presented a limited number of sentences which only randomly described the array by discussing the animals' positions, two animals at a time. This study illustrates both the process of integration in memory and also subjects' ability to make inferences which go beyond the information presented. Barclay discussed this study as support for the notion that "the memory representation of a sentence can contain more information than was linguistically expressed." Other studies which reported subjects' ability to infer relationships and construct linear arrays from partial input have been carried out by Steinheiser (1972) and Potts (1972).

Subjects also have demonstrated spontaneous production of inferences concerning more general spatial relations

among objects. Bransford, Barclay, and Franks (1972), had subjects listen to a set of sentences and then later complete a recognition test on those sentences. An example of the materials is the following sentence pair:

(1) The painter stood on the platform and the boy sat under him.
(2) The painter stood near the platform and the boy sat under him.

An individual subjects' acquisition list included one of the above sentences as:

(1′) The painter stood on the platform and the boy sat under it.
(2′) The painter stood near the platform and the boy sat under it.

The critical difference is that sentence (1′) is implied by sentence (1) but sentence (2′) is not implied by sentence (2). If subjects make inferences about the spatial relations among objects when the basic information is presented, then subjects presented sentence (1) in the acquisition set would be unable to differentiate sentences (1) and (1′) in the recognition test. Subjects presented sentence (2), however, would be expected to correctly recognize sentence (2′) as a new sentence. This predicted outcome was reported by Bransford, Barclay, and Franks in support of the inference hypothesis.

Barclay and Reid (1974) conducted a more pointed test of the inference hypothesis by asking whether different types of inferences from the same memory representation were distinguishable. The five inference types were derived from a base structure which expressed the relative values of a white, green, blue, and yellow car in terms of the dimensions, weight, and speed. Subjects were presented an acquisition set of eight sentences and were later (unexpectedly) asked to recall the sentences. The set of inferences (true, non-old sentences) recalled was then subdivided into inference types. The following excerpt from their study describes the inference types used as classification categories.

(1) Old: acquisition sentences. *The white car is lighter than the blue one*, and *The blue car is lighter than the yellow one.*

(2) Equivalent: a logical equivalent of an Old. *The blue car is heavier than the white one.*
(3) Correlate: a sentence which maps a relationship stated in an Old from one dimension to the other. *The white car is faster than the blue one.*
(4) Correlate Equivalent; the logical equivalent of a Correlate. *The blue car is slower than the white one*
(5) Transitive 1: a transitive inference in which both premises and conclusion refer to the same dimensions. *The white car is lighter than the yellow one.*
(6) Transitive 2: a transitive inference in which the premises refer to one dimension, the conclusion to the other. *The white car is faster than the yellow one.*

The results were that these categories of inferences were not distinguished from one another, nor from the original items in memory. Looking at the group data over four trials, the proportions of inferences recalled (commission errors) reflected the proportion represented on each trial. The proportions did not decrease over trials as would have occurred if the categories had been distinguishable in memory.

Johnson, Bransford, and Solomon (1973) have also demonstrated subjects' ability to remember inferences of sentences. Subjects read descriptive stories such as

> John was trying to fix the bird house. He was pounding (looking for) the nail when his father came out to watch him and to help him do the work.

Control subjects read the same description with the verb phrase changed as indicated by the parenthesis. A later recognition test included inference items. The inference of the above example was,

> John was using the hammer to fix the bird house when his father came out to watch him and to help him do the work.

On the recognition test, subjects were at least as likely to "recognize" inferences to be old sentences as they were to recognize actual old sentences. This was not the case with the control group, which did not differ from the experimental group on mean number of yes-responses during recognition on old sentences but had significantly fewer such responses on

inference sentences. The experimental subjects, then, were unable to differentiate between old sentences and sentences consonant with implications of the old sentences.

Similarly, Fillenbaum (1974) had subjects read sentences, some of which were written in an uncommon form. The extraordinary sentences were disordered conjunctive sentences with "perverse" threats (e.g., Get a move on or you will catch the bus). Subjects were instructed to, "paraphrase or rephrase the sentences as accurately as you can, conserving meaning as completely as possible." The subjects interpreted most sentences in the direction of conforming to customary order and connections among events. In this example, prior knowledge and expectation played such an important role in the interpretive process that it was actually the inferred meaning of sentences which was retained, rather than that presented. This issue of the relative roles of inference and literalism has been explored in pilot work discussed in a thesis prospectus by Till (1974). Till constructed a list of sentence pairs which were identical except for the subject-word. The subject noun for each sentence was chosen so as to limit the range of possible interpretations of the sentence. An example of one sentence pair is:

> The parents fixed the airplane.
> The soldier fixed the airplane.

Given these two sentences, the effectiveness of the recall cue, *glue* or *wrenches*, depends on its relation to the inference made during comprehension. For example, subjects reading the first sentence are likely to infer that the instrument of fixing was glue (not wrenches), and thus *glue* will serve as a more effective recall cue for that sentence. This study is similar to that mentioned by Anderson and Ortony (1973) using sentences of a different form.

Tzeng (1972) has reported data which support the notion that subjects make inferences based on materials presented and over time construct schemas which integrate the original information and the inferences. In this study, Tzeng used a continuous presentation-recognition procedure. Subjects were presented three blocks of 12 semantically interrelated sen-

tences, one sentence at a time. For each sentence. the subjects had to respond "old" or "new." Some of the sentences were repetitions of old sentences; other sentences were not old but were logical inferences of the old sentences. In the beginning of the sequence, the new valid sentences were correctly classified as new, a high percentage of the time. As the sequence progressed, however, the new valid sentences were more often classified as old. Tzeng discussed this result as a consequence of subjects developing schematic representations of the sentences over time and making their subsequent judgments on a comparison of the presented sentence with the schema rather than with the stored form of the individual sentences.

Kintsch and Monk (1972) required subjects to read a paragraph and then answer a question which required the subjects to make an inference from the information in the paragraph. Paragraphs were constructed in pairs such that each pair contained the same propositions but were arranged in either a syntactically simple or syntactically complex structure. The results of this study were that, although subjects took more time to read and comprehend the syntactically complex paragraphs, there was no comparable difference in accuracy of correct inference or in reaction time to verify inferences based on the paragraphs. The experimenters concluded that the information was stored similarily for both simple and complex paragraphs and that subjects were able to draw inferences from the presented information accurately and with facility.

Similarly, but with reading time controlled, Rosenberg and Parkman (1971) presented subjects with information describing a set of genealogical relations and used measures of speed and accuracy to draw conclusions about how the subjects stored and retrieved the information in memory. The passages were presented in paragraphs or as a sequence of sentences. In both conditions, the order of the sentences was scrambled or logically ordered. They found that subjects were able to make accurate inferences based on the information presented. Using response latencies to indicate "distance" between stored properties in memory, they reported that response latencies for verifying specific inferences did not vary with order of passage

presentation. That is, different organizations and memory loads did not affect the form of the representation in memory but did reduce the amount learned in the less ordered conditions.

The ability of subjects to make logical inferences from information presented has also been demonstrated in children. In a study similar to that by Tzeng (1972), Paris and Carter (1973) found that both second- and fifth-grade children made many false positive recognition responses to sentences which were new, but semantically consistent with old sentences. Paris and Upton (1974) ran a prompted recall study much like the studies by Till (1974) and Anderson and Ortony (1973) with kindergarten, second- and fourth-grade children. They used recall cues which were instrumental case relation inferences of the previously heard sentences. Consistent with the adult data, they found that post-kindergarten children spontaneously constructed and remembered inferences from sentences presented. Their data also suggested that this ability increases with age.

Data have been presented in support of the occurrence of inferences constructed from information presented. Implicit in this point is the notion that mental representations may contain more information than exists in the linguistic input. Given this point, then an interpretive approach to semantics in terms of a deep-structural analysis alone is not sufficient to fully analyze the cognitive process of sentence memory.

Summary and Implications

This paper has reviewed a body of research which argues for a constructive theory of memory and comprehension. The data presented support five characteristics of the constructive process: 1) That individual words do not have fixed meanings and thus cannot be considered to be stable units of language. Several studies were presented which demonstrate that even individual word meaning, often considered to be a fixed and stable unit of language, is determined by various manipulations of context. 2) That the comprehension process assumes semantic prerequisites. These include thematization of materials as well as prior knowledge on the part of the subjects. 3) That information is integrated in memory. Integration is

reflected by subjects reorganizing, consolidating and otherwise constructing representations in memory from the ideas presented. 4) That memory for the exact material input does not endure. Once language segments are integrated in memory, the original pattern of input cannot ordinarily be recovered. 5) That logical inferences are spontaneously constructed from information presented. Data presented affirm the notion that while subjects integrate information presented, they have substantially more information at their disposal in memory than has actually been presented. This additional information often represents inferences drawn from the original input.

The five characteristics support the general context-dependent nature of comprehension and memory. Each characteristic highlights the fact that subjects do not treat sentences or even words as isolated linguistic objects and, also, that what is remembered from a comprehended sentence often exceeds the product of a surface- or even deep-structural analysis. An adequate deep structural analysis may be a necessary but certainly not sufficient tool for deriving what is retained in sentence comprehension.

The research presented in this paper argues that a constructive process of memory is a more accurate and integrative way to characterize comprehension and memory than is usually considered. The constructive orientation has direct implications to real world experiences outside of the laboratory tradition because it takes into account the multitude of contextual factors which operate to affect memory. These factors are usually eliminated or ignored in standard memory research. Interpretive models of memory such as that proposed by Anderson and Bower (1973) posit that single sentences are individually parsed at the time of input and therein semantically interpreted. Such models are tied to the sentence as a linguistic unit and are insensitive to the role of context in processing prose and discourse. The requisite conditions for construction, on the other hand, are not artificial or contrived but are representative of everyday experiences as well as most situations in memory and comprehension research.

Further, the constructive orientation is consistent with the notion that memory is an ever-developing, dynamic process. Another implication of the material presented in this paper is that any model of memory which does not include a mechanism for reconstructing information stored in memory as new related information is processed, falls short of looking at the whole picture of memory. A more complete and generalizable view of memory is to consider it as an interaction of the information presented with the context in which it is presented and the existing knowledge schemata of the subject.

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